A **reflection** is the change in direction of a wave when it reaches the surfaces and bounces off of it. All light that hits your eyes originally came from a light source, like the sun or a fluorescent bulb. This light reflected off of objects and then reached your eyes. To see your own reflection in a lake, light had to have reflected off of you towards the water and then reflected off of the surface of the water to finally reach your eyes.

When light travels through one medium, it travels in a straight line. A **medium** is a term for the substance that light travels through. We can visually demonstrates the motion of light through ray diagrams. A **ray** is a straight line with an arrowhead representing light travelling in one direction.

Ray diagrams can be used to predict the location, size and shape of the shadows of two objects. Consider the picture below (from your textbook). We can see how light rays emitted from one light source travels towards two solid objects at different distances from the light bulb. The object which is closer to the light source casts a larger shadow than the further object.

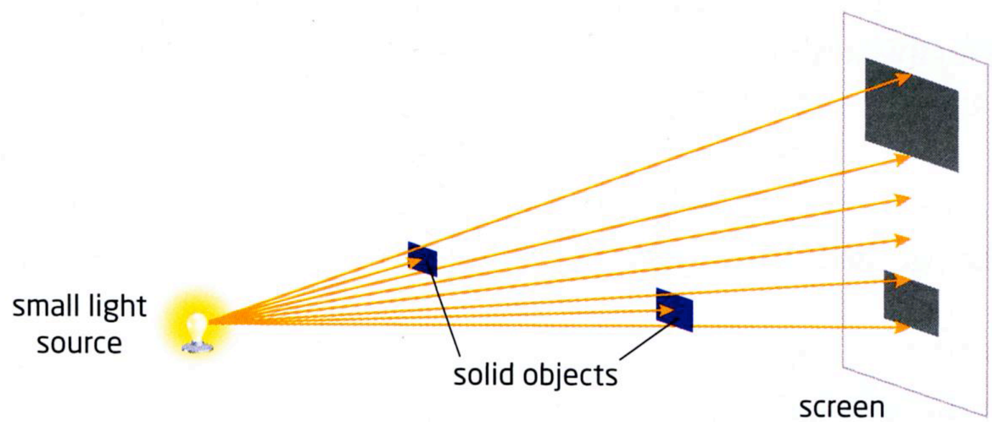


Figure 10.13 Using the fact that light travels in straight lines, you can predict the size and shape of shadows formed by opaque objects.

Fermat's Principle: This principle states that light will follow the path that will take the least amount of time. In other words, light will take the shortest path. This principle can be used to predict where light will go after reflecting off of a surface.

The **incident ray** is the ray of light which heads towards a surface. The **angle of incidence** is the angle that the incident ray makes with the **normal** (a perpendicular line drawn from the point of contact of the incident ray with the surface). The **reflected ray** is the ray of light which reflects off of the surface. The **angle of reflection** is the angle between the reflected ray and the normal. The incident ray, normal and reflected ray all lie on the same plane.

The **Law of Reflection** states that the angle of incidence (θ_i) always equals the angle of reflection (θ_r) such that the incident and reflected ray, as well as the normal, lie on the same plane. In other words,

$$\theta_i = \theta_r$$

The **normal** is simply an imaginary line perpendicular to the plane of incidence whether the plane is flat or irregular.

Draw the reflections of a ray through this maze.

Images in Plane Mirrors:

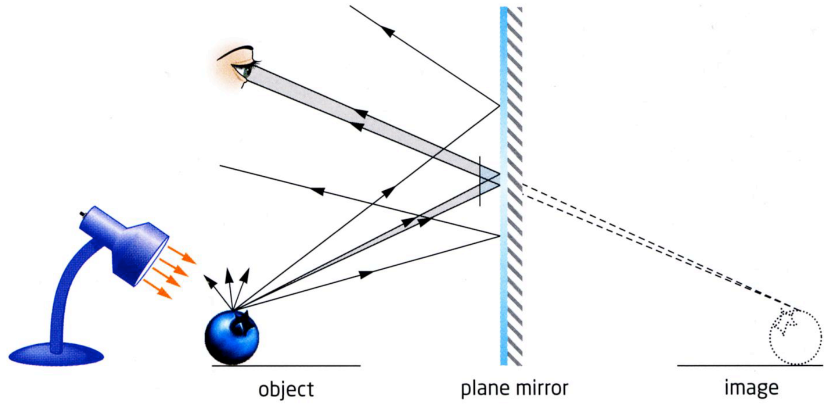
If you place an object in front of a mirror, you will see an image of that object shown in the mirror. We can use the laws of reflection to figure out where the image will be and what the image will look like.

The picture on the next page shows a blueberry placed in front of a mirror. Light rays will reflect off of that blueberry in all directions. Some will head towards our eyes (allowing us to see the blueberry) while others will travel towards the mirror.

When these rays reach the mirror, they will reflect off of the mirror. Some of these rays will reach our eyes allowing us to see the image of the blueberry in the mirror. Our brain is tricked by the mirror. It assumes that when we light rays hit our eyes, it must have come from a straight line. If we extend straight lines from our eyes back towards the mirror, along the reflected ray, we can determine where our brain thinks that the light rays are originating from. These extended rays are represented by the dashed diagram in the figure. Therefore our eyes “see” the blueberry at this spot “behind” the mirror.

The image that we see “behind” the mirror is a **virtual image**. A virtual image is one in an image in which light rays only appear to be originating from. To determine whether an image that we see is real or virtual, we can place a screen where we think the image is. If light rays hit the screen to form an image, then this image is real. If no light rays hit the screen and there is no image seen, then the image is virtual.

Figure 10.15 No matter where the observer's eye is located, the image will always be in the same place. All the reflected rays can be extended backward and will reach the same point. The dashed lines represent extended rays.



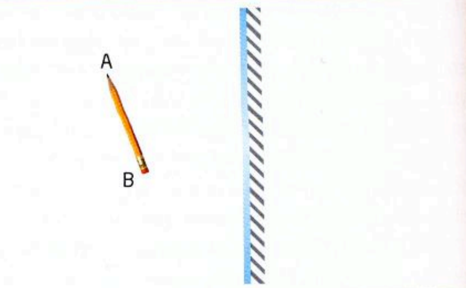
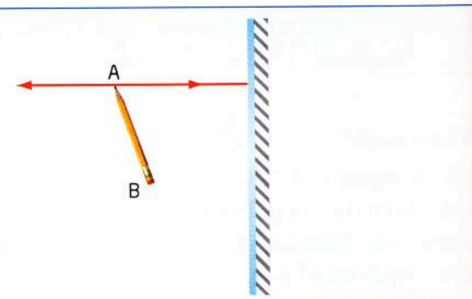
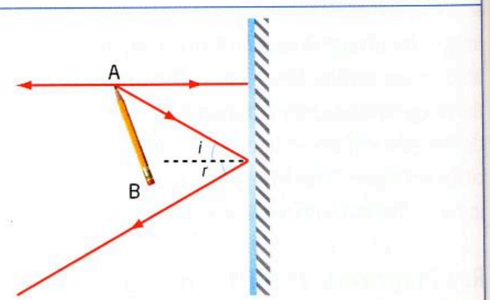
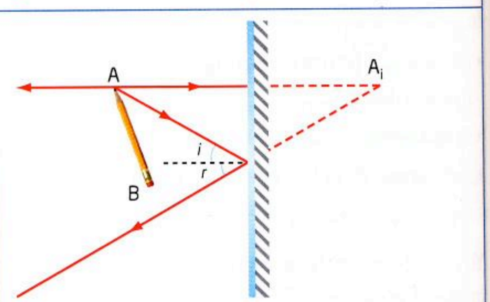
There are four general characteristics to any image:

1. Its location (closer than, further than or the same distance as the object and the mirror)
2. Its orientation (upright or inverted)
3. Its size (with respect to the object)
4. Its type (real or virtual)

Again, we can use ray diagrams to predict these four characteristics of an image. For a plane mirror, the image of an object will have the same size, the same distance, the same orientation and will be virtual.

If you look at written text in a mirror, the writing will look like it is written backwards. This phenomenon is called **lateral inversion**.

Table 10.1 Locating an Image in a Plane Mirror Using a Ray Diagram

Description	Example
1. Draw a line to represent a mirror. Add hatch marks to show the non-reflecting surface of the mirror. Draw a simple object. The distance between the mirror and the object is called the *object distance*. Label a point at one end of the object "A," and label a point at the other end "B."	
2. Draw an incident ray from point A directly to the mirror at a 90° angle. Because this line is normal to the mirror, the angle of incidence is zero. Therefore, the angle of reflection is also zero. The reflected ray goes directly backward along the same line as the incident ray.	
3. Draw another incident ray from point A at an angle to the mirror. At the point where the incident ray hits the mirror, draw a normal. Measure the angle of incidence with a protractor. Using the knowledge that the angle of reflection is equal to the angle of incidence, draw the reflected ray.	
4. Using a dashed line, extend both reflected rays behind the mirror until they meet. Label this point "A_i" to indicate that it is the image point of the tip of the pencil.	
5. Repeat steps 2 to 4 for point B. Join A_i and B_i using a ruler. The distance between the mirror and the image is called the *image distance*.